Reversibility of Different Types of Capital Flows to Emerging Markets

Ozan Sula and Thomas D. Willett

January 2006

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Ozan Sula[**]
Claremont Graduate University

Thomas D. Willett
Claremont Graduate University
and
Claremont McKenna College

Abstract

Most of the emerging market currency crises are accompanied by sharp reversals or "sudden stops" of capital inflows. We investigated whether some types of capital flows are more likely to reverse than others during these crises. Foreign direct investment is usually considered stable while portfolio investment is frequently depicted as the least reliable type of flow. Recent statistical testing has yielded conflicting results on this issue. We argue that a major problem with recent studies is that the degree of variability of capital flows during normal or inflow periods may give little clue to their behavior during crises and it is the latter that is most important for policy. Using data for 35 emerging economies for 1990 through 2003, we confirm that direct investment is the most stable category, but find that private loans on average are as reversible as portfolio flows.

[*] We thank Graham Bird, Eric Chiu, Arthur Denzau, Ozkan Eren, Hisham Foad, Sam Schreyer and Clas Whilborg for their comments and suggestions. We are solely responsible for any errors.
[**] Send correspondence to Ozan Sula, Department of Economics, Western Washington University. Email: ozan.sula@wwu.edu.

I. Introduction

Currency crises that are accompanied by sharp reversals or "sudden stops" of capital inflows have severe effects on emerging market economies including sizeable output losses (Calvo 1998, Hutchison and Noy 2002, Edwards 2005).[1] The increased frequency of these types of financial crises over the last decade and the fact that many of these episodes were preceded by large capital inflows has generated heated discussions about international capital flows. There are several views in the literature regarding the role of capital flows in financial crises. One popular hypothesis is that some types of capital are more likely to reverse than others; in other words, the composition of capital inflows can have an important effect on an economy's vulnerability to a financial crisis.

The empirical studies that have investigated this hypothesis have generally evaluated the time series properties of different types of capital flows. Flows are labeled as "hot" or "dangerous" based on their relative volatility. The underlying rationale is that a more volatile form of capital will be more likely to fly out of the country in the event of a crisis. Conventional wisdom says foreign direct investment (FDI) is the least volatile and that short-term flows are generally more volatile than long-term ones. Portfolio flows (stocks and bonds) are often singled out as being the most dangerous.

Recent empirical studies, however, do not always confirm these conventional views. For example, Claessens et al. (1995) find that by their measure foreign direct investment is as volatile as the other types of flows. The same study finds no significant difference between long-term and short-term flows. In contrast, Chuhan et al. (1996), reach the opposite conclusion. Sarno and Taylor (1997) find portfolio flows to be the

[1] The expressions 'reversal' and 'sudden stop' are used as interchangeably throughout the text. A reversal is defined as a large fall in capital inflows, i.e., a change from a high inflow state to a low inflow or outflow state.

most volatile type of capital yet Willett et al. (2004) show that the largest outflows during the Asian financial crises were bank loans. Gabriele et al. (2000) conclude that all types of capital flow, including foreign direct investment, contributed to instability during the 1990s.

We argue that examining the volatility of capital flows during normal periods is not necessarily informative about the behavior of capital flows during times of unexpected crises. The contradictory findings in the empirical literature are due at least in part to the limited time periods over which the volatility was investigated. Samples were often dominated by periods of large inflows. From a policy perspective, the magnitude of reversals during crises is more relevant than volatility during normal periods. Mean-reverting monthly or quarterly volatility causes relatively minor problems for balance of payments policy compared to a relatively stable inflow that displays a large reversal during a crisis.

We investigate the link between volatility during normal periods and the size of reversals during crisis periods. Our focus is on the behavior of total capital flows, foreign direct investment, private loans and portfolio flows in 35 emerging market economies for the period 1990 to 2003. We find that volatility during inflow periods is not a good predictor of the size of reversals during crises. Then, in a simple linear regression framework, reversals are regressed on the accumulated previous capital inflows and the estimated model parameters are used to compare the degree of reversibility of capital flows. Results from both parts suggest that the composition of capital flows matters during crises. While FDI is found to be the least reversible type of flow, loans are found on average to be as reversible as portfolio flows.

Our results provide a link between the "sudden stop" literature, which investigates the determinants and consequences of sudden stops, and the "hot money" literature, which evaluates the volatility of different types of capital flows. The first literature has not focused yet on the components of capital flow behavior while the latter has not sufficiently differentiated between crises and normal periods.

The paper is organized as follows: Section II provides a background on different types of capital flows and their expected behavior during crisis and normal periods. Section III briefly summarizes the methodologies and findings of recent studies. Section IV examines the relationship between sizes of reversals during crises and volatility during normal periods. Section V presents an alternative empirical framework for testing and comparing the reversibility of different types of capital flows using linear regression methods. Section 6 concludes.

II. Major Components of Capital Flows

In this section, we briefly review the major categories of private capital flows investigated in this study and the arguments made about their likely relative volatility. We categorize private capital flows based on the types of investor. We believe that the changes in the incentives facing different types of investors are the major determinants of the behavior of flows during a crisis. This leads to three distinct types of capital flows: foreign direct investments, portfolio flows and private loans.[2]

[2] A common alternative is categorization based on maturity. In this case, private loans are divided into two categories; short-term and long-term loans. In addition, portfolio debt flows are sometimes included in these categories based on their maturity whereas portfolio equity flows become a separate category. We do not use this alternative both because of insufficient data and concern that the standard methods of distinguishing short from long-term flows are not able to capture this distinction well.

Foreign Direct Investment Flows

Foreign direct investment is widely considered to be the most stable form of capital flows, both during normal and crisis periods. It consists mainly of fixed assets and is highly illiquid and difficult to sell during crises. FDI is also influenced more by long-term profitability expectations related to a country's fundamentals than speculative forces and interest rate differentials.

The stability view of FDI has several caveats, however. One must distinguish between the degree of reversibility of the bricks and mortar of investment as opposed to the full range of activities associated with the investment. Once the physical investment is made, it is irreversible, but the flow of funds associated with that investment is not necessarily irreversible (Sarno and Taylor, 1997). While most of the fundamental factors that determine FDI do not change suddenly during normal times, a sudden change in perceptions of these fundamentals during a crisis may disrupt these flows of funds. Direct investors may contribute to a crisis by accelerating profit remittances or reducing the liabilities of affiliates toward their mother companies (World Bank, 2000). These are all classified as non-FDI flows. This means that FDI may cause instability by allowing other types of flows to mask it. Flows may enter the country under the heading of FDI and leave under other accounts. If financed locally FDI may also create outflows such as bank lending or portfolio outflows. Foreign investors can use the physical assets as collateral to obtain a loan from banks and can then place the funds abroad (Bird and Rajan, 2002). In addition, the distinction between portfolio flows and FDI can be somewhat arbitrary since, according to the International Monetary Fund's (IMF) classification, an equity investment above 10 percent is considered FDI.

Much of the observed stability of direct investment flows is likely to be real however. The depreciation that often accompanies a crisis can increase the profitability of many types of direct investments. For example, if the market value of a firm falls substantially, then inflows may be generated to take advantage of a perceived bargain (Krugman, 2000).

Portfolio Flows

Portfolio flows consist of both bond and equity investments. Portfolio investors can sell their stocks or bonds more easily and quickly than FDI and these flows are often considered to be the hottest of the various major types of capital flows.

Portfolio flows are also more susceptible to informational problems and herding behavior. For example, Calvo and Mendoza (2000) show how global diversification of portfolios and informational problems can cause rational herding behavior in financial markets.[3] Furthermore, Haley (2001) argues that mutual fund managers are small in number and they show similar patterns in their trading decisions. They tend to invest or leave a market at the same time causing high instability.

While these factors can explain high volatility of portfolio flows, they neglect an important feature of stock and bond markets. Concerns about portfolio flows come mainly from the high liquidity; at the first sign of trouble investors can easily sell their stocks and bonds. However, most of the time portfolio investors are too late to sell their assets without incurring large losses. To the extent that markets are efficient, the immediate hit to asset prices means that future increases are roughly as likely as decreases. With more price adjustment there is less incentive for future quantity

[3] Calvo and Mendoza's model applies primarily to portfolio flows.

adjustments. The price of these assets can adjust very quickly (Bailey et al. 2000, Willett et al 2004, Williamson 2001). Therefore, the high volatility of portfolio flows during normal times does not necessarily imply a large reversal during crises. There is empirical evidence that financial markets in emerging market economies do deviate from full efficiency,[4] so we would not necessarily effect the full effect of a crisis to be on portfolio prices, rather than quantities, this capacity for large rapid price adjustments suggests that we should not be surprised if the quantity adjustments are often moderate.

Private Loan Flows

Private loans consist of all types of bank loans and other sector loans including loans to finance trade, mortgages, financial leases, repurchase agreements, etc. They have been a relatively neglected category.[5] Sarno and Taylor (1997) suggest that they are the least important fraction of capital flows in the 1990's in terms of relative size. They argue that, "Because of the liquidity of commercial loans to developing countries once they are made, one might expect commercial banks to look more closely at the underlying economic fundamentals before committing funds and therefore to be less prone to sudden changes of heart. Moreover once funds are committed this way, it may seriously jeopardize a bank's chances of recovering its investment if lending is suddenly withdrawn." Gabriele et al. (2000) classify loan flows as somewhat volatile, in between portfolio flows and FDI, but not very important compared to the other types of capital flows. As will be illustrated in the following sections, recent data provides a strongly

[4] For a recent review of studies on this issue, see Williamson 2005.
[5] See, however, Bailey et al. 2000, Willett et al. 2004, and Williamson 2001 and 2005.

contrasting picture on the importance of private loans during the 1990s. Especially during the Asian crises, private loans had the largest reversals.[6]

Due to the illiquid nature of bank loans, their prices do not adjust automatically, and thus banks adjust the quantity of lending instead. During times of financial distress, uncertainty and risk rise which in turn is reflected in interest rates. Depending on the severity of the situation, rising interest rates further increase the probability of a default, making loan flows more risky. In this case, banks may have larger incentives to pull out from crisis countries in order to cut their losses (Bailey et al. 2000, Willett et al. 2004, Williamson 2001). Credit rationing takes place and foreign investors retrieve their short-term debt and halt lending and rolling-over existing long-term debt. This implies that volatility of loans may differ substantially during crisis and normal periods.

In summary, there are strong reasons to believe that FDI will be the most stable type of private capital flow, although the true degree of stability is likely to be somewhat less than is captured in official statistics. It is not clear, however, whether we should expect substantial differences in the degree of instability of portfolio investment versus loans. There are important counter arguments to the popular view that portfolio flows are the most dangerous and it is difficult, if not impossible, to judge a priori the relative importance of the arguments on each side. Thus we must turn to the empirical evidence.

III. Previous Empirical Research on Volatility Rankings

The existing empirical studies focus on the overall volatility of capital flows. The implicit assumption is that if time series data shows high volatility for a particular type of flow, then this capital flow component is "hot" and has a high potential for reversal in a

[6] Ibid.

crisis. These studies use various statistical methodologies ranging from simple standard deviation calculations to more sophisticated econometric techniques such as Kalman filtering and vector autoregression.

Claessens et al. (1995) analyze the distinction between short and long-term capital flows during the 1970s and 1980s.[7] They compared various volatility measures like standard deviations and coefficients of variation for flow types and conclude that there is no significant difference among them in terms of volatility. Claessens et al. also investigate persistence, i.e., whether an inflow is likely to disappear or reverse itself in the near future. They look at autocorrelations, half-life responses, and the predictability of flow series using an autoregressive model. They find very little evidence for significant distinctions among types of flows. One interesting result from their analysis is that the volatility of total flows is less than its components. This suggests that capital flows are highly substitutable. To investigate this, they examine how flows interact. Their results show that there is high negative correlation between long-term and short-term flows. Their main conclusion is that in most cases there are no significant distinctions between the time series properties of short and long-term capital movements. They are all volatile and unpredictable.

In a later study, Chuhan, Gabriel and Popper (1997) reach the opposite conclusion for the period between 1985 and 1994.[8] In the first part of their study, they perform similar persistence tests and find similar results. Both the stationarity and autoregressive model tests show that there is little significant difference across flow types. Yet, Chuhan

[7] The time period varies across countries. Overall they cover the period between 1972 and 1992. Their long-term flows are bonds, longer maturity loans and reserves. Short-term flows are bank deposits, shorter maturity loans and other short-term official flows.

[8] They classified their capital flows into portfolio (equities and bonds), FDI and long-term and short-term other investments.

et al. argue that similar univariate patterns among series can mask substantial differences if one type of capital flow causes the other one, and this can be discerned only when the series are viewed collectively. To illustrate this point, They first look at the Granger causalities for different types of inflows to the same country. They find evidence that short-term inflows follow other flows, but that direct investment does not. Second, they perform cross-country vector autoregressions. Their results show that short-term inflows are more sensitive to changes in short-term inflows elsewhere than is direct investment. In a short section of the paper, Chuhan et al. investigate the Mexican crisis. This is one of the few examples in the recent literature that examines the composition of capital outflows in a particular crisis episode.[9] They find evidence of Granger causality from Mexican short-term outflows to other short-term outflows in Latin American countries. They find no evidence of Granger causality from Mexican FDI to FDI in other emerging markets. Their main conclusion is that composition matters. Chuhan et al. find univariate similarities in the sample but they show that those similarities mask real differences. Multivariate analysis shows that short-term flows respond more dramatically to disturbances in the other flows and in other countries than does direct investment; therefore, short-term flows are hot. They also conclude that differences in long-term flows and portfolio flows are less pronounced.

Sarno and Taylor (1999) apply Kalman filtering to measure the relative size and statistical significance of the permanent and temporary components of various types of capital flows for 1988 to 1997.[10] They argue the flows that are more likely to have sudden reversals would have large temporary, reversible components. They find that the

[9] See Willett et al. (2004) for another example.
[10] They classified capital flows as bonds, equities, FDI, official flows and commercial bank credit.

permanent component in explaining the variance of flows is very large in direct investment, and that portfolio flows have a large temporary and reversible component, suggesting that portfolio investment is particularly dangerous. However, their study includes only a small portion of the Asian crisis in which bank flows show the largest reversal.

IMF (1999) uses sign changes and coefficients of variation of net capital flows to assess volatility during the 1980s and 1990s. They find that while FDI is the least volatile flow, long-term flows have been as volatile as the short-term flows.

Gabriele et al. (2000) also employ coefficient of variation and standard deviation measures to assess the volatility and instability of capital flow types for the period 1975 to 1998.[11] They find that volatility and instability increased during the 1990s. Gabriele et al. argue that instability overall has increased with foreign direct investment and that sudden withdrawals of FDI from East Asian economies during the Asian crises contributed to the reversals. By using Granger causality tests, they also investigate the relation between the inflows and outflows of different types of flows within the same period across countries. Their results indicate that outflows and inflows move in the same direction during crisis periods, and in opposite directions during normal periods. Gabriele et al. main conclusion is that short-term flows are very volatile, and in general all types of capital flows contributed to the instability during the 1990s.

An important problem of the previous studies is the limited time periods over which capital flow volatility was studied. Most of these studies focus on time periods dominated by inflows and include little data on the recent major currency crises in

[11] Their short-term flows include portfolio flows, short-term private loans, foreign currency and deposits and official short-term flows.

emerging economies. When volatility is analyzed for a longer period without a distinction between crisis and non-crisis periods, the implicit assumption is that components of capital flows behave similarly in both periods. As we discussed in the previous section, investors may act on different incentives during crises than during normal times. To the extent that the difference in behavior is large, the volatility approach will be misleading, especially if crisis periods are under-represented in the sample.

IV. Volatility as a Measure of Reversibility: Extending the Previous Work

To assess reversibility of different types of capital flows, we reapply the volatility approach with separation of crisis and non-crises periods. The sample contains 35 emerging market countries from 1990 to 2003.[12] Capital flow data is taken from balance of payments statistics published by the IMF (Appendix A). Types of capital flows are classified as foreign direct investment, portfolio investment (including portfolio debt and equity flows), private loans (including both bank and other sector loans), and total capital flows (which is the financial account of the balance of payments including all private and official flows).

In order to differentiate between crisis years and normal periods, we employ the methodology of the currency crisis literature, where years of currency crises are identified using conventional exchange market pressure indices. Currency crises are constructed from "large" changes in an index of currency pressure, defined as a weighted

[12] Countries are included if they are contained in the Emerging Markets Bond Index (EMBI+) or the Morgan Stanley Country Index (MSCI) following Fischer (2001). In addition Bangladesh, Botswana, Croatia, Hong Kong, Romania, Syria, Uruguay and Zimbabwe are added to the sample due to their large capital inflows during the 1990s.

average of monthly real exchange rate changes and monthly (percentage) reserve losses.[13] The weights are inversely related to the variance of change of each component over the sample for each country. Crisis years are identified by changes in the pressure index that exceed the mean plus 2.5 times the country-specific standard deviation (Appendix B).[14]

Table 1-a presents net capital flows as a percentage of GDP for each type of capital during crisis years.[15] In the first two rows, average percentages for the whole emerging markets and the Asian crises countries are presented. The rest of the rows are for some of the recent well-known crisis episodes. A negative number represents a net outflow. The table shows that except for private loans, all types of capital continued to flow in to the emerging economies during the crisis years. In general, foreign direct investment inflows are the largest. Portfolio flows decrease during crises, but net outflows occurred only from Indonesia, Malaysia and Turkey.

Net flows during crises do not necessarily portray the severity of reversals or sudden stops. In a situation where previous capital inflows were large, a sizeable fall in inflows could cause a financing or adjustment problem. Thus, a capital account crisis does not necessarily require an outright reversal of capital flows; for example, a fall in capital inflows from five to one percent of GDP could cause more problem than a

[13] In the original formulation of crises index by Eichengreen et al. (1996) interest rates were also included but because of data problems interest rates have typically been excluded from the construction of these indices for developing countries. For further discussion of these issues see Willett et al.(2005) and the references cited there.

[14] Many studies use either two or three standard deviations. Our results are robust to alternative crises calculations.

[15] We used GDP as a scale measure. Other possible alternatives are the money supply and international reserves.

reversal from a 1 percent inflow to a 1 percent outflow. A measure that would capture the magnitude of the fall in capital inflows is the following:[16]

$$\frac{K_{t-1} - K_t}{GDP_{t-1}} \tag{1}$$

where K is a capital flow component. A larger positive value for this ratio indicates a larger reversal.

Table 1-b presents reversal measures.[17] Except for FDI, all types of capital flows display large reversals during crises. The fall in capital inflows is largest for private loans during the Asian crises. Other emerging market crises witness similar falls in both portfolio and loan flows. The data also suggest that FDI usually does not reverse. On the contrary, it increases in some of the episodes, providing crude evidence for its stability. During the Asian crises, the largest outflows were from the private loan category, presumably mainly bank loans. Thailand, for example, experienced a fall in capital inflows of 17 percent of GDP and almost all of this fall was in private loans. Reversals in Indonesia and Philippines were predominantly from portfolio investors. Both crises in Turkey were associated with reversals in private loans, while the reversals in Russia and Mexico were mainly portfolio flows. There is no clear-cut conclusion in terms of reversal sizes across different crises episodes for private loans and portfolio flows. When all reversals are averaged across emerging markets, reversal sizes are similar.

Next, volatility for each type of flow is calculated. Previous studies have employed several different methodologies, the most popular ones being the standard

[16] Radelet and Sachs (1998), and Rodrik and Velasco (1999) use this measure to identify capital account reversals.

[17] A good example for justification of this measure is the case of the Mexican crisis in 1994. The data suggest that during the crisis, portfolio inflows were positive and private loans were negative. On the other hand, the reversal measure provides a more accurate indication, as the fall in portfolio flows to Mexico was about 5 percent of GDP and the fall in the private loans was almost 10 times smaller than that.

deviation and coefficient of variation. At this point, it is worth mentioning some of the issues with the measurement of the statistical indicator of volatility. The choice of the indicator will have important effects on the comparison of volatility across capital flow types, and across countries.

The standard deviation provides an absolute measure of variability, but does not allow for comparison with other countries and provides a weak basis for interpretation. For example, an annual standard deviation of 100 million dollars would have a miniscule effect on financial markets of a country receiving large amounts of capital inflows like China, but such fluctuations could cause serious financial instability in a smaller economy like Ecuador.

Another problem with the standard deviation is that it may be biased if capital flows are non-stationary. Surges of capital inflows preceding crises have substantial time trends, which would bias the standard deviation measure to be larger than if the trend component were removed. With a limited number of observations, removing the trend could be a serious challenge.

The coefficient of variation, the ratio of standard deviation to its mean, provides a measure of volatility than can be compared across countries. It is a popular indicator, but the type of volatility it indicates is of little policy relevance because it does not take size into account. For example, consider two types of capital inflows. The first has a mean of two and a standard deviation of four. The second has a mean of five and a standard deviation of 10. The coefficient of variation is two for both of them. Both of these flows are equally volatile. Without additional information on the relative sizes of these countries we cannot conclude which volatility is more important.

From a policy perspective, the size of absolute variation or variation in relation to the average level is not likely to be as important as the variation in relation to the size of the country's international reserves, national income or financial sector. The standard deviation of the reversal term (1) satisfies this requirement and handles the caveats of standard deviation as an indicator of volatility: GDP as a denominator enables comparison of variability across countries and conveys policy relevant information about the magnitude of flows. Furthermore, taking the difference of capital flows usually takes care of potential non-stationarity problems.

To evaluate and to compare the policy relevance of indicators we first present coefficient of variations and then standard deviations of each type of capital flow, calculated based on the reversal term (1) (Tables 2-a and 2-b).

The upper panel in each table shows the volatility calculated using the whole sample. The bottom panel presents calculated volatility that excludes the crisis years.[18]

There is no clear pattern for coefficient of variations across countries and different flows. The sizes of coefficients are very sensitive to the inclusion of crises years in the sample. These simple statistics can be interpreted in two ways. One is that there is no systematic difference in terms of volatility among different types of capital flows. The other is that the coefficient of variation is not a reliable indicator of policy relevant volatility. We are inclined towards the second explanation.

Table 2-b presents the standard deviations of the reversal measure. There are several consistent patterns. First, FDI has the lowest volatility among all flows and it does not differ substantially between volatility calculated from the whole period and non-crisis periods. This is evidence of the stability of this type of flow, and is consistent with

[18] We exclude both the year of the crisis and the following year to isolate the normal-period volatility.

conventional wisdom and most previous studies. A second pattern is that the volatility of private loans is usually close to or higher than the volatility of portfolio flows. Third, volatility calculated for the whole period are higher than non-crisis period volatility for total flows, and with some exceptions, this also applies to private loans. On the other hand, excluding crisis years does not decrease the volatility of portfolio flows.

So far the evidence suggests that private loans are as volatile as portfolio flows and that FDI is stable. The relevant question for policy is whether a higher volatility implies a higher reversibility. Next, we present the correlations of reversal size during crises and volatility calculated from the whole period and from non-crisis periods for each type of flow.

Correlations are very low when the coefficient of variation is used as the volatility indicator (Table 3-a). The alternative volatility indicator, the standard deviation, provides a closer association with the sizes of reversals (Table 3-b). When crisis years are excluded from the standard deviation calculations, the correlation coefficients are low for total flows and private loans (0.26 and 0.21). Since private loans represent the largest share of capital flow reversals in most crises, this finding shows that their volatility during normal times has little, if any, explanatory power for their behavior during crisis periods. As would be expected, the correlations increase dramatically when crisis years are included.

Table 3-b also shows that the coefficients for portfolio flows and FDI are larger and do not change much with the inclusion of crises. FDI has a negative correlation, however, implying that a higher volatility for FDI under normal periods is associated with a lower size of reversal during crises. This peculiar result is caused by the tendency

of FDI to increase during crises and it implies that volatility during normal periods does not necessarily imply a larger reversal during crises for every type of flow. To summarize, the volatility-reversal relationship is sensitive to the inclusion of crises years for private loan flows, stronger for portfolio flows, and is counter-intuitive for FDI. This suggests that a different methodology is required to analyze the reversibility of capital flows.

V. An Alternative Empirical Model of Reversibility

In discussions of sudden stops and the variability of capital flows it is often assumed that international capital will act, at least to some degree, differently from domestic capital. On this assumption a country is likely to have larger outflows in a crisis, the greater is the amount of foreign capital already in the country, i.e., the larger have been the previous capital inflows the larger the capital outflows in a crisis. We therefore also investigate the size of net outflows in relation to the preceding cumulative capital. We know, of course, that domestic capital also tends to flow out during crises. Indeed, many countries that have attracted little foreign capital have had huge capital outflows from capital flight. Thus, we should not expect to find a strong regular relationship between outflows during crises and previous capital inflows. Ideally, we would like to analyze separately reversals of both domestic and foreign flows. Unfortunately, data that would allow us to conduct such analysis is not publicly available on a broad basis.[19]

[19] Domestic residents' transactions are represented by the assets on the balance of payments statistics. Data on these are limited for portfolio flows and private loans. Our net capital inflow measure includes assets for some countries but it is not possible to assess the size of possible asset outflow during a crises with the available data.

Consider the following equation for the size of reversals:

$$\text{Reversal}_{j,i,t} = \alpha_j + \beta_j A_{j,i,t} + \varepsilon_{j,i,t} \ , \qquad (2)$$

$j = 1,2,...J$
$i = 1,2,...N$
$t = 1,2,...T$

where *j* indexes the type of capital flow, *i* indexes countries and *t* indexes crisis years. The dependent variable is the reversal measure for the capital flow type *j* in country *i* during the crisis in year *t*. $A_{j,i,t}$ is the accumulated previous capital inflows; it is constructed as the sum of the previous five years of capital flows relative to GDP.

Heterogeneity across types of flows is introduced through the constant term, slope coefficients and error terms. If components of capital flows differ in terms of their reversibility, then by comparing the significance and size of the parameters of the model for different values of *j*, a reversibility ranking could be established. Therefore, the expected sign for the slope coefficient is positive. Based on equation (2), four alternative model specifications are tested. The results for the first three models are in Table 4 and the fourth model in Table 5.

1- *Ordinary Least Squares Model for Total Net Capital Flows*

Emerging market economies receive large amounts of capital inflows during normal periods and the composition of these inflows varies. If different types of capital flows have different reversal potential, then without taking the composition into consideration, previous total net capital flows should not explain the size of total reversal. To test for this, we take the reversal total capital flows as the dependent variable and regress it on its cumulative flows. The coefficient for accumulated inflows and the overall

fit of the model are insignificant; previous total cumulated capital inflows have no explanatory power over the size of total reversals during crises.[20]

2- *Pooled Ordinary Least Squares Model with a Robust Covariance Structure*

Sometimes countries receive outside financial help from developed nations and the IMF during crises. Since total capital flows are represented by the financial account of the balance of payments, bailouts and emergency loans may be included, and this may not reflect the correct size of a reversal. To test for differences of reversals across capital flow types, observations for the three major types of capital flows are pooled. In this model, the slope coefficient and the constant term are assumed to be the same for all types of capital flows. Differences across types of capital flows may arise from different variances or from the covariances of the disturbances of the equations. The model is estimated with the feasible generalized least squares method. We control for the groupwise heteroscedasticity where each group is a major type of capital flow. The results are similar to the first model. All coefficients are insignificant and the overall fit of the model is very low.

3- *Least Squares Dummy Variable Model*

Results from the first two models show that we cannot explain the size of reversals with accumulated inflows if we assume that all types of capital flows have the same behavior during crises. The composition of capital flows needs to be taken into consideration.

[20] Several studies have found the size of total capital flows to be significant in explaining crises likelihood (See for example: Radelet and Sachs 1998, Domac and Peria 2000). What makes our analysis different is the focus on the reversal size instead of the crisis probability.

Capital flow types might have different degrees of reversibility due to some unobservable factors. The fixed effects approach takes α_j to be a flow type specific constant term in the regression model. The unobserved effects are reflected in this constant term. Using the same pooled observations from the previous model, we add two dummy variables, one for portfolio flows and one for FDI. The dummy for private loans is excluded from the regression so the constant term becomes the base for this type of flow. The dummy coefficients for the remaining capital flow types measure the extent to which they differ from private loans. In this case a negative sign for these dummies indicates less reversibility relative to private loans, and a positive and significant constant term would reflect the reversibility of private loans.

Results show that the constant term is positive and significant, demonstrating a high reversibility of private loans. The dummy coefficient for portfolio flows is close to zero and insignificant; portfolio loans are as reversible as private loans. The coefficient for the FDI dummy is negative and significant. Accumulated FDI flows actually "cause" FDI to increase during crises, a finding that confirms the stability of FDI as the volatility measurements from the previous section indicated. The slope coefficient is positive and significant.

4- *Seemingly Unrelated Regressions Model*

So far the slope coefficients have been restricted to be the same across flow types. It is quite plausible that the slopes would differ across capital flow types. In this case, the slope coefficient would also provide an indication of reversibility. For example, based on our previous findings, one would expect a lower coefficient of accumulated inflows for

FDI. Figure 1 illustrates the relationship of cumulative flows and reversal sizes; it provides some preliminary evidence in favor of this model.

One way to estimate the slopes is to run OLS regressions for each flow type, and then compare coefficients. However, a more realistic approach is to assume that disturbances for each flow type during a given crisis are correlated. During unexpected crises, risk perceptions and expected returns for all types of capital flows can change dramatically and it is safe to assume that these changes have some common terms. The main question is whether the magnitude and direction of these changes are equal, which would otherwise reflect on the varying size of the reversals. By relaxing the constraint that all three types of flows have the same slopes, we obtain a three-equation seemingly unrelated regression model.

The results are shown in Table 5. The slope coefficient for private loans is significant and larger than any other flow type's slope coefficient. If one ranks the slope coefficients as well as the constant terms, the same order is reached as in the previous model. Private loans have a slope coefficient of 0.29, larger than the portfolio slope coefficient of 0.20. However the difference is not statistically significant. Both of these coefficients are significantly larger than the FDI coefficient. We find a negative and insignificant coefficient for FDI. This also confirms that FDI does not tend to reverse during crises. The explanatory powers of the models are also stronger compared to previous models. Except for the FDI regression, both private loan and portfolio flow regressions have larger R-squares.

VI. Conclusion

In this study, we investigate the reversibility of components of capital flows to emerging markets. The paper's central focus is on differentiating crisis from non-crisis periods. Our empirical analysis confirms that foreign direct investment is the most stable type of capital flow during crises. Contrary to popular view, portfolio flows are not clearly the most reversible; private loans, a neglected type, are as reversible as portfolio flows. We also find that volatility of capital flows is not a good predictor of the size of their reversal.

The results of the empirical analysis do not provide a full explanation of the size of reversals during crises. However, they do provide support for the hypothesis that the composition of capital flows matters for sudden stops and the magnitude of capital outflows during currency crises. We find that both private loans and portfolio flows can be highly reversible, with the former being the most reversible in most of the crisis episodes. We also confirm the conventional view of FDI. This type of flow is quite stable and the least reversible. However a word of caution is needed. This paper does not investigate the possibility that flows that enter a country under the disguise of FDI may leave under the mask of other flows.

The evidence presented in this paper does not speak directly to the debate over capital controls, but it does have important implications for the demand for international reserves and international risk management. While substantial inflows of financial capital generally do signal that a country has been doing many things right, they may also signal that the potential for future currency and financial crises is increasing. Such potential warning signs should be noted by both national governments and private investors.

This suggests that governments should set aside some of the reserve inflows accompanying large financial capital inflows as a protection against the country's increased vulnerability. Holding sufficient reserves may both reduce the probability of suffering a crisis `a la second-generation crisis models and even if the preventive role fails, they provide financing that can help cushion the effects of private capital outflows. The incorporation of such considerations into optimal (or at least reasonable) reserve levels in an important topic for analysis.[21]

[21] For initial efforts along these lines see Kim et al. (2005) and Li, Sula and Willett (2006).

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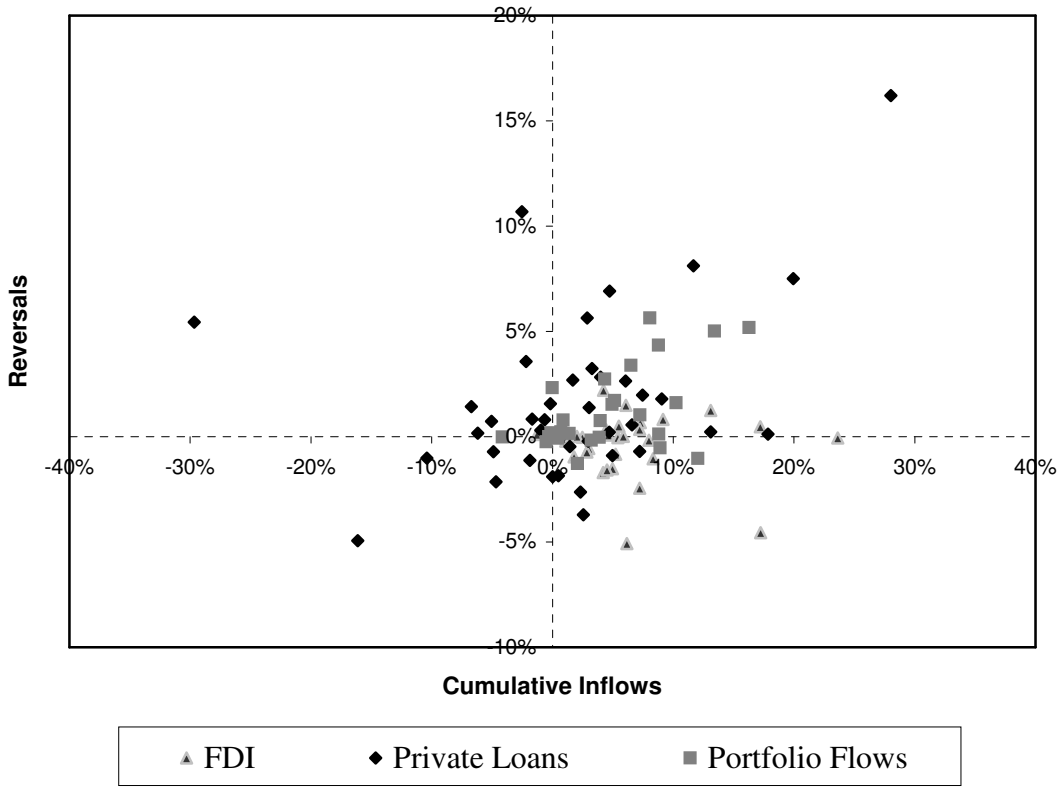
Figure 1
Capital Flow Reversals and Accumulated Inflows*



* The reversal measure is the ratio of difference of crises year net capital inflows and the previous year net capital inflow divided by the previous year's GDP. The cumulative inflows are defined as the sum of total capital flows in the five years preceding the crises divided by the GDP of the year before crisis. See the text for details.

Table 1-a
Net Capital Flows During Crises as Percentage of GDP*

	Total Flows	FDI	Private Loans	Portfolio
All Emerging markets	1.1%	1.9%	-1%	0.1%
Asian Crises	0.3	2.2	-2	0.9
Indonesia 97	-0.3	2.1	-1	-1.2
Korea 97	-1.7	0.5	-4.7	2.6
Malaysia 97	2.2	5.1	-2.3	-0.2
Philippines 97	7.7	1.5	6.1	0.7
Thailand 97	-6.5	2.1	-8.3	2.4
Mexico 94	3.8	2.6	-0.1	1.8
Russia 98	-2.2	0.5	-2.8	1.2
Turkey 94	-2.3	0.3	-2.7	0.6
Turkey 01	-6.2	1.4	-4.9	-1.9

* Due to the effects of devaluations, dollar GDP values fall during crises. This would give a misleading measure of capital inflows. To prevent this problem, the previous year's GDP is used in calculations.

Table 1-b
Capital Flow Reversals During Crises as Percentage of GDP*

	Total Flows	FDI	Private Loans	Portfolio
All Emerging markets	1.6%	-0.4%	1.6%	1.1%
Asian Crises	8.2	0	6.4	1.7
Indonesia 97	5.1	0.7	1.4	3.4
Korea 97	5.9	-0.1	6.9	0.1
Malaysia 97	7.2	-0.1	7.5	0
Philippines 97	5.7	0.4	0.1	5.6
Thailand 97	17	-0.8	16.2	-0.5
Mexico 94	4.3	-1.6	0.6	5
Russia 98	2.8	0.4	0.4	2.2
Turkey 94	7.3	0	5.6	1.5
Turkey 01	9.8	-1	8.1	2.3

*The reversal measure is the ratio of difference of crises year net capital inflows and the previous year net capital inflow divided by the previous year's GDP. See the text for details.

Table 2-a
Volatility of Capital Flows: Coefficients of Variation*

Total Sample	**Total Flows**	**FDI**	**Private Loans**	**Portfolio**
All Emerging markets	-6.9	-4.2	-11.1	-71.7
Asian Crises Countries	2.8	44.8	3.5	-8.7
Indonesia	-9	62.7	-7	-5.5
Korea	-6.3	-12	-9.3	-8.2
Malaysia	-33.6	-4.7	-39.9	6.8
Philippines	10.8	159.2	12.8	-51.1
Thailand	52.3	19.1	60.7	14.3
Mexico	-4.5	-4.6	-7.8	-9.3
Russia	-5.2	-2.1	-4.3	12.4
Turkey	-8	-41.8	-6.7	-55.4

Crises Years Excluded	**Total Flows**	**FDI**	**Private Loans**	**Portfolio**
All Emerging markets	-7.4	-362.7	-3.7	27.7
Asian Crises	3.7	19.2	2.3	-9.1
Indonesia	-3.4	-5.8	-2.6	-1.2
Korea	-2.1	89.8	-1.9	-2.5
Malaysia	-8	-2.6	-4.1	5.2
Philipines	34.4	11.3	22.1	-5.8
Thailand	-2.5	3.2	-2.1	-41.6
Mexico	-2.9	-7	-4.8	-2.2
Russia	-3.7	-1.3	-3.7	-7.7
Turkey	-1.8	-3.8	-2.5	-7.9

*The ratio of the standard deviation to the mean of net capital flows. Coefficients of Variation should be interpreted in absolute values.

Table 2-b
Volatility of Capital Flows: Standard Deviations*

Total Sample	**Total Flows**	**FDI**	**Private Loans**	**Portfolio**
All Emerging markets	4.5%	1.9%	3.9%	3%
Asian Crises	4.5	1.3	4.7	2.1
Indonesia	3.1	1.6	3	1.2
Korea	2.7	0.5	2.6	1.5
Malaysia	6.6	2.3	6.2	1.5
Philippines	4.2	1	5.9	4.8
Thailand	5.7	1.2	5.9	1.7
Mexico	3.6	0.9	2.1	3.2
Russia	5.2	0.3	3.4	2.6
Turkey	5.3	0.5	4.3	2.1

Crises Years Excluded	**Total Flows**	**FDI**	**Private Loans**	**Portfolio**
All Emerging markets	4%	2%	4%	3%
Asian Crises	3.6	1.3	4.1	2.1
Indonesia	2.3	1.5	2.8	0.6
Korea	2.1	0.5	1.3	1.3
Malaysia	6.6	2.2	6.2	1.6
Philippines	4	1.1	6.7	5.3
Thailand	3.1	1	3.5	1.7
Mexico	2.8	0.9	2.2	2.6
Russia	5.7	0.3	3.9	2.7
Turkey	3	0.1	2.2	2.2

*Standard deviation of ratio of first difference of net capital inflows to previous years GDP. See the text for detailed explanation of this measure.

Table 3-a
Correlations of Reversal Size and Volatility (Coefficient of Variation)*

	Crises Years Excluded	Total Sample
Total Flows	-0.07	0.28
FDI	0.03	0.01
Private Loans	0.21	-0.06
Portfolio Flows	-0.09	0.05

Table 3-b
Correlations of Reversal Size and Volatility (Standard Deviations)

	Crises Years Excluded	Total Sample
Total Flows	0.26	0.39
FDI	-0.51	-0.57
Private Loans	0.21	0.57
Portfolio Flows	0.5	0.64

Table 4
Cumulative Inflows and Reversals: Models 1,2, and 3

	1. OLS (Total Flows)	2. Pooled OLS	3. Least Square Dummy Variable Model
Cumulative Inflows	0.104 (-0.106)	0.102 (-0.061)	0.135 (-0.038) ***
Constant	0.004 (-0.018)	0.005 (-0.005)	0.014 (-0.004) ***
FDI Dummy			-.026 (-0.006) ***
Portfolio Dummy			-0.008 (-0.007)
R-Square	0.06	0.06	0.18
Number of Observations	40	100	100

Standard deviations are in parentheses.
* Significant at 10%; ** significant at 5%; ***significant at 1%

Table 5
Cumulative Inflows and Reversals: Model 4

	IV. Seemingly Unrelated Regressions Model		
	FDI	**Loans**	**Portfolio**
Cumulative Inflows	-0.034 (-0.055)	0.295 (-0.074)***	0.203 (-0.056)***
Constant	-0.003 (-0.005)	0.012 (-0.008)	0.003 (-0.004)
R-Square	0.01	0.26	0.3
Number of Observations	27	27	27

Standard deviations are in parentheses.
* Significant at 10%; ** significant at 5%; ***significant at 1%

Appendix A
Data Sources

Variable	Source
Total Net Capital Inflows	Defined as the sum of financial account of the balance of payments excluding international reserves. IFS line 78BJDZF
FDI	Foreign Direct Investment, defined as direct investment in reporting economy IFS line 78BEDZF
Private Loans	Defined as the sum of other investment assets and liabilities for banks and other sectors. IFS lines 78BQDZF + 78BRDZF + 78BUDZF + 78BVDZF
Portfolio Flows	Defined as the sum of portfolio assets and liabilities IFS lines 78BFDZF + 78BGDZF
GDP in National Currency	Gross Domestic Product taken from World Development Indicators and IFS. Converted into American Dollars. IFS line 99B..ZF
International Reserves	Reserves excluding gold. Monthly changes are used to calculate the exchange market pressure index. IFS line .1L.DZF
Nominal Exchange Rate	National Currency per US Dollar, Period Average. Monthly changes are used to calculate the exchange market pressure index. IFS line ..RF.ZF

Main Source: IMF International Financial Statistics CD-ROM, September 2004

Appendix B
Currency Crises and Speculative Attacks

Argentina				
Bangladesh	1990,	2000		
Botswana	1992,	1998,	2001	
Brazil	1990,	1998		
Bulgaria	1994,			
Chile				
China	1992,	1994		
Colombia	1997,	1999,	2002	
Croatia	1993,			
Czech Republic	1999,			
Egypt	1991,			
Hong Kong				
Hungary	1991,			
India	1991,	1993		
Indonesia	1997,			
Israel				
Korea	1997,			
Malaysia	1997,			
Mexico	1994,			
Morocco	1990,			
Pakistan	1993,	1995,	1997,	1999
Panama				
Peru	1990,			
Philippines	1990,	1997		
Poland				
Romania	1990,			
Russia	1998,			
South Africa	1998,	2001		
Sri Lanka	1993,	1998,	2000	
Syrian Arab Republic				
Thailand	1997,			
Turkey	1994,	2001		
Uruguay	2002,			
Venezuela				
Zimbabwe				